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INFORMATION REPORT

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III. APPENDICES

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Appendix 'A'

Chemical Warfare and Biological Warfare - No information.

Appendix 'B'

Guided Missiles - See separate sheets attached.

Appendix 'C'

Electronics - No information.

Appendix 'D'

Naval - No information.

Appendix 'E'

Army - No information.

Appendix 'F'

Air - No information.

Appendix 'G'

Scientific Order of Battle - (a) Establishments - Nil
(b) Personalities - See separate sheet attached.

IV. ANNEXURES

Annexure 'A' - List of Machine Tools, OKB, Workshop.

" 'B' - Figures 1 - 21.

GUIDED MISSILES

Activities of Zavod 456

1. [redacted] the following information on the activities of Factory No. 456 from November, 1946 to September 1950:- 50X1-HUM

(a) About the time the Germans arrived, plans were drawn up for the production layout of the OKB (experimental design department)* and the Zavod (Factory) of Zavod 456 at KHIMKI and for another factory, place not specified.

(b) [redacted] about 150 complete propulsion units (25-ton and 35-ton) were produced at KHIMKI, 1948 - 1950. 50X1-HUM

[redacted] 50X1-HUM

(c) During 1950 production in the Zavod tailed off to the manufacture of an occasional A-4/35 unit.

(d) 4-5 sets of assembly jigs and component tools for the A-4/25 and A-4/35 engines were made in the Zavod. One set was retained (as were the OKB tools), the others were despatched to an unknown destination by mid-1949.

(e) Series production of the 100-ton motor could not begin before early 1953.

V-1 (f) [redacted] some 60 standard V-1 flying bombs, some of native Russian manufacture, were produced between early 1947 and mid-1949. 50X1-HUM
[redacted] 50X1-HUM

(g) Instructional Courses were arranged for Russian Technical personnel of Factory 456 at an Institute in MOSCOW.

(h) Movements of Staff. [redacted] information indicating distant establishments connected with guided missile work. 50X1-HUM

(i) Awards. [redacted] personnel connected with guided missiles had received a higher proportion of merit awards than [redacted] expected; possibly indicating high priority for guided missiles. 50X1-HUM 50X1-HUM

(See Figure 1 for layout of Factory 456 and ANNEXURE "A" for list of Machine Tools).

2. Orders for the layout of the factory were signed by the Ministry of Aircraft Production. The layout proposed was unsatisfactory and in consequence a committee of 15 - 20 men from the Ministry visited the factory for a period of six months and were allocated their own offices. The Germans were called in one by one to give advice.

* [Note: The correct translation of this abbreviation is Special Construction Bureau.]

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3. three separate establishments were under consideration and that their planned production was to be:- 50X1-HUM

(a) The OKB - 10 complete units/month
(b) The ZAVOD -100 complete units/month
(c) An unknown factory with a capacity ten times that of the ZAVOD.

It should be noted, however, that the OKB was essentially concerned with research into production techniques.

4. The committee re-visited at intervals during 1948, 1949, and 1950 and one member eventually became a shop manager.

OUTPUT IN THE OKB

5. A-4/25 ton Propulsion Unit

In 1947 5 complete German A.4 engines were assembled, tested, and despatched to Factory No. 88, KALININGRAD. these were for demonstration purposes. Preparation for A-4 Unit manufacture was in progress in 1947 and very early 1948 to Spring 1949, when production tailed off. In addition Soviet A-4/25 Units were made in the OKB. Some were tested at the LOI test tower after it had started in Spring of 1945. Most of the engines were despatched to Factory No. 88. 25 were produced in all. Russian parts were gradually introduced during 1948, after which all components were of Russian manufacture except the valves in the fuel system, of which sufficiently large stocks of German manufacture were held to satisfy requirements until 1949/mid 1950. The main alcohol valve presented the most acute manufacturing difficulties as the work had to be carried out to very close limits. Considerable experience was necessary before the difficulties caused by these fine limits could be overcome. However, the necessary preliminary work had been done by September 1950 and the required experience obtained. by that time the valves could have been made in the OKB had they desired to do so and the Russians were able to manufacture them after that date Prior to this and possibly subsequently, valves were made at SONDERHAUSEN. At BERLIN in the Spring of 1947

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6. A-4/35 ton Propulsion Units. This was being developed during 1948, and up to May, 1950, some 10 complete A-4/35 motors were manufactured and made in the OKB. These were tested and despatched to Factory No. 88, KALININGRAD. Production towards the end of this period had slowed to odd one's and two's, presumably to meet an experimental requirement. representation of a complete A-4/35 motor is at Figure 2.

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7. Two A-4/35 ton combustion chambers were constructed with the heads strengthened by welding stiffening rubs to the outer casing. The ribs ran radially from the centre of the head.

8. Combustion Chambers

During the period 1948/50 an additional 20 each of A-4/25 and A-4/35 combustion chambers, without the turbine assembly, were produced. some of the A-4/25 and A-4/35 combustion chambers had been sent to KUIBYSHEV.

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OUTPUT in the ZAVOD

9. although planned production for the Zavod was ten times that of the OKB, the target output was never approached and that actual production did not exceed three times that of the OKB. Apart from spare combustion

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chambers, this would have amounted to no more than some 140 motors in all. [redacted] the total production at 150 units, which is in general agreement with the foregoing detail. 50X1-HUM

JIGS AND TOOLS - A-4/25/35 ton Motor

10. The situation regarding jigs and tools for the complete 25-and 35-ton motors seems to have been:-

(a) One full set was brought from Germany.

(b) Four or five sets for construction and assembly were built at KHIMKI.

(c) Of the above 5 or 6 sets, 2 or 3 remained and the others were sent away to an unknown destination. These sets were sent away either at the end of 1949 or the beginning of 1950.

(d) Based on German methods, four sets of jigs and tools should provide a production capacity of 200 motors/month. [redacted] Russian production figures would be less than the German.) 50X1-HUM

[redacted] the OKB were supplied with dies for the combustion chamber but that these came from outside Factory No. 456.

NOTE: It was difficult to clarify the point as to whether the jigs and tools were for assembly only, or for construction and assembly. Further discussion made it reasonably clear that in fact construction and assembly was the proper description.

11. [redacted] the German engineer HENNING knew the destination of the tools sent away. 50X1-HUM

12. A-4/25 and A-4/35 ton COMBUSTION CHAMBERS - MANUFACTURING PROCESS

1. Locate section 1 of venturi on cone jig (Figs 3).
2. Spot weld to next section, Section 2 (Figs 3).
3. Spot weld to Section 3.
4. Spot weld to Section 4.
5. Lift and place vertically on expanding chuck.
6. Turn over to horizontal and complete welds. (Fig. 4).
7. Tack wing stringers longitudinally to outside of inner casing (Fig. 5).
8. Attach combustion chamber head after machining base flat and having inserted 1.5 mm. distance pieces (Fig. 6). First spot welded in position, distance pieces removed and weld completed.
9. Outer casing assembled in similar manner.

NOTE: [redacted] sketches indicate that machined rings containing film coolant entry ports are welded into the inner casing during assembly as was the German practice. [redacted] dimensions are as follows:- 50X1-HUM 50X1-HUM

A-4/25 - length 1400 mm., throat diameter 400 mm.
A-4/35 - " 1800 - 1900 mm., throat diameter 460 mm.

13. Concentricity of sections during assembly is checked by scriber attachment (Fig. 7).

14. Location jigs are employed in assembly of alcohol entry ports to combustion chamber (Fig. 8) and for the thrust frame supports (Fig. 9).

15. The assembly line utilises wheel trolleys; and, where required, raised working platforms are provided. The trolleys are fitted with a wooden block for locating the combustion chambers. The height from the bottom of the trolley wheel to the top of the raised working platform was approximately 2.8 meters.

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[redacted] there were 8 stands in all, as follows:- 50X1-HUM

(1) The thrust frame is placed in position and critical distances checked.

(2) The turbine and pump are attached.

(3) The peroxide and potassium permanganate equipment is installed for the steam propulsion.

(4) Compressed air bottles are installed.

(5) Electrical valves and cables fitted.

(6) Testing.

(7) All screws and rivets secured.

QUALITY OF OUTPUT

16. [redacted] Soviet materials were of higher quality than the materials used in German production. He quoted as an example the rustless steel used in the combustion chamber nozzle inserts. 50X1-HUM

17. The steels used in the construction of the combustion chamber were:-

(a) 25 x r C.A. (25 Kh. G.S.A.)

Carbon	0.25 - 0.29%
Manganese	0.80 - 1.10%
Chromium	0.80 - 1.10%
Silicon	0.90 - 1.20%
Nickel	0.30% max.
Phosphorous and Sulphur	0.06% max.

Tensile strength 45 - 65 Kgs/mm. (28.6 - 41.3 tons/sq. in.)
Elongation, 18% minimum.

(b) 30 x r C.A. (30 Kh. G.S.A.) Carbon, about 0.30 - 0.35%
Rest of composition not specified.

18. Soviet standard of workmanship was adequate, given sufficient time and supervision. [redacted] all instructions issued to workmen were in the most minute detail - far more so than is usual in the West. Production techniques were written and distributed. [redacted] 50X1-HUM 50X1-HUM

TESTING OF COMBUSTION CHAMBERS

19. These were subjected to:-

(a) Visual inspection.
(b) Air pressure test (see Fig. 11).
(c) Hydraulic pressure test.
(d) Dimensional check.
(e) X-ray testing of welded seams, introduced in 1949.
(f) Calibration.
(g) Functioning test at LOI, usually 3-4 days after testing at the factory.

(a) - (e) were carried out in the OKB (Hall 55) and [redacted] additionally, [redacted] X-ray examination of all the seams in the outer casing were made but only the longitudinal seams in the inner case were so tested. 50X1-HUM 50X1-HUM

(f) was carried out in the Zavod. [redacted] 50X1-HUM

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FAULTS FOUND BY TESTING

20. [redacted] finally approximately 5% gave trouble during workshop test as follows:- 50X1-HUM

(a) Trouble was encountered with all units comprising the first batch of 10 combustion chambers sent to LOI for functional tests. This was partly the fault of unsuitable testing technique, e.g., bad fuel injection control, and subsequent rejects were reduced to 10%. 80% of the rejects were remediable. Only 2 or 3 combustion chambers were complete rejects among the estimated total of 150 (A-4/25 and A-4/35)tested over the period.

(b) Apart from difficulties with the valves, welding troubles seemed due to inefficient heating and ventilation troubles in the shops which led to too rapid cooling after heat treatment and welding operations.

21. Typical examples of faults encountered were:-

(a) Discontinuity in welds.
(b) Internal burning of the throat.
(c) Expansion joints cracking at welds.
(d) Pipe fractures.
(e) Burning out of injection nozzles.
(f) Burning out of injection nozzle housings.
(g) Glass wool insulation around the outlet end of the venturi sometimes became damp and blew up due to the steam pressure generated under test. (A-4/25 ton motor).
(h) Holding down lugs fractured.

[redacted] 50X1-HUM

REPAIR PROCEDURE

23. Defects were discussed with the designer and [redacted] Soviet 'opposite number' ZASSANOV, the production engineer in charge of OKB manufacture. The work to be carried out was decided upon by LIST and IVANOV in conjunction with ZASSANOV. ZASSANOV then made arrangements for the OKB engineers to carry out the work.

24. The control department kept all clerical records of the repairs [redacted] 50X1-HUM

25. A very full report on each job was written [redacted]

26. Units originally manufactured in the Zavod were returned there for repair and dealt with by the ZAVOD inspectorate.

MANUFACTURING DIFFICULTIES

27. As already related, the electrical control gear for fuel valves presented manufacturing difficulties and the Soviets resorted to production in the Eastern Zone of Germany.

28. [redacted] welding techniques with the steels used for combustion chamber manufacture proved difficult and that the electrode used - "ZIETTERS 55" - were not as good as their German counterparts. 50X1-HUM

NOTE: This difficulty is not apparent since the steels specified are readily welded and, in any case, Soviet welding techniques in turbo-jet engine manufacture have been established as equal in quality to Western counterparts.

NEW PROCESSES

29. [redacted] although ZASSANOV was excellent by Soviet standards and clever in German estimates, the Soviets had introduced no new welding techniques; all were of German origin. 50X1-HUM

30. To begin with, combustion chambers were bonderised to prevent rust but supplies of the I.G. FARBEN material used were soon exhausted. Eventually, a Soviet copy of the process was made but this gave trouble as it was thicker and broke away, thus blocking up the holes. So far as is known, the Soviets have persevered with the process in order to produce rust-resistant surfaces.

31. The potassium permanganate tanks were made of stainless steel, but the hydrogen peroxide and the air bottles were of ordinary steel lined with an acid-resisting coating. All the compressed air bottles were obtained from outside sources which were unknown [redacted] the only difficulty experienced in the production of these bottles was the conical neck thread. They were tested to a pressure of 300 atmospheres and were about 40 cm long and 15 cm wide. [redacted] their content was 9 litres. The hydrogen peroxide container was egg-shaped about 50 cm. long and 30 cm. wide. The oxygen and alcohol containers were 4.2 cu.m. and 5 cu.m., respectively, and were made of aluminum. This is the standard German equipment and [redacted] tanks of a similar size made of aluminum were made and installed in the final missile at Factory 88. [redacted] 50X1-HUM 50X1-HUM 50X1-HUM 50X1-HUM

32. [redacted] the Soviets display great interest in metal spraying processes. [redacted] this process was used more in Russia than in Germany and that the Russians appeared to place exaggerated value on its importance. [redacted] an Institute in MOSCOW was engaged in chromium spraying to prevent corrosion and to increase shelf life. [redacted] samples of nickel and chromium sprayed items [redacted] came from this "Welding" Institute. [redacted] metallic chromium could be sprayed as easily as brass, copper, or nickel. [redacted] the fluid metal was sprayed by compressed air at a pressure of 4-5 atmospheres. [redacted] In the works, metal spraying was carried out with copper and brass. 50X1-HUM 50X1-HUM

The 35-ton THRUST A-4 MOTOR (PROJECT 101) 50X1-HUM

33. [redacted] the following as the major differences between the A-4/25 and A-4/35 combustion chambers. 50X1-HUM

1. The A-4/35 was modified to permit the flow of coolant alcohol around the section at the outlet of the venturi, which was uncooled in the A-4/25 but insulated with glass wool. The modification consisted of an extension of the double-walled construction over this section. (See Fig. 12 for detail).

2. The coolant connecting pipes between the head of the combustion chamber and the annuli feeding the coolant entry rings were increased from four to eight in number. (See Fig. 13 for detail. The coolant pipe shown, however, is presumed to continue down to further coolant entry ports situated near the venturi outlet.)

3. The number of coolant entry holes through the inner casing of the combustion chamber was doubled. Additionally, the entry ports were shrouded to prevent injection of alcohol into the combustion space. The shroud also deflected the coolant along the wall of the chamber and achieved a more even distribution of the coolant film. (Fig. 14)

OTHER MODIFICATIONS ADOPTED

34. (a) The choke was removed from the input side of the turbine to increase rate of flow.

(b) The hydrogen peroxide was decomposed by means of a solid catalyst.

(c) The air bottles of the A-4/25 were replaced by a ring tank of special steel. (Fig. 15).

N.B. [redacted] this was for air storage and not H.T.P., as seems more likely. 50X1-HUM

(d) [redacted] the overall object was to move the C. of G. rearwards (to allow for the carriage of more oxidant and fuel?). 50X1-HUM

(e) Shortening of the feed pipes for this purpose caused inelasticity which was remedied by the use of more resilient connections.

The 100-ton ROCKET MOTOR (PROJECT 103)

35. [redacted] 50X1-HUM
was asked how the A-4 could be developed to produce 100 tons thrust. Dipl. Ing. ROSENPLATER (Manager of BLEICHERODE, also a guidance expert) had all the details of this model.

36. [redacted] no idea as to the intended use of the 100-ton engine - [redacted] 50X1-HUM
Soviet interest was founded on a "what was good enough for the Germans is good enough for us" principle rather than on a reasoned requirement. 50X1-HUM

GENERAL CHARACTERISTICS OF THE 100-ton MOTOR

37. [redacted]
paraffin was to be used for fuel and liquid oxygen as the oxidant. 50X1-HUM

38. The weight of the 100-ton unit was to be 500 kgs., which compared favourably with the 430 kgs. of the A-4/25 units (Fig. 16 shows main dimensions of the combustion chamber).

39. The design of the combustion chamber centres on a copper inner casing brazed to a steel outer casing (Fig. 17). Because the inner casing, which is machined to form a water coolant jacket, was extremely thin, it presented novel development problems to the Soviets.

40. The turbine and pump assemblies follow the A-4 in principle so far as fuel and oxidant are concerned. In addition, water is pumped to the coolant jacket, and hydrogen peroxide is pumped to the reaction chamber from its tank. The two extra pumps are ganged to the fuel and oxidant pumps.

MANUFACTURING PROCESSES AND DIFFICULTIES

Brazing

41. It appeared that the method of brazing copper to steel, which had resulted from a study of several alternative processes, was nearing final solution. The brazing build-up prior to heating was: steel - flux - .05 mm brass foil - flux - copper. The flux was a whitish colour usually applied in liquid form, but sometimes as a powder; the composition was unknown [redacted] 50X1-HUM [redacted] brass foil was found to tear during the brazing process and [redacted] [redacted] the Russians resorted to spraying the brass [redacted]

The reason [redacted] had not seen the work done was because it had been carried out in a special secret department which had been set up within the OKB. This department worked for both the OKB and the ZAVOD. It was kept secret and German personnel were not granted access. [redacted] 50X1-HUM [redacted] it was not politic [redacted] to have anything to do with departments [redacted] not directly connected. [redacted] 50X1-HUM [redacted] avoided any show of curiosity. [redacted] The secret department was under the control of a Russian who had a female as his deputy. [redacted] the woman was a most unpleasant personality 50X1-HUM but could not recollect either name. [redacted] the department employed about 80 persons. [redacted] they used galvanising baths and carried 50X1-HUM out anti-corrosion treatment.

42. Since the inner casing was very thin (1 mm.) it was necessary to maintain positive contact over its entire surface with the outer steel casing during the brazing process. This was achieved by evacuating the space between inner and outer casings to .03 atmospheres and by use of an assembly jig (Jig "D", Fig. 18). The intention was to use normal capillary jointing, eventually, it is presumed, in an electrical furnace.

43. The combustion chamber was divided into seven sections (see Fig. 16), each section individually undergoing the brazing process which joined inner and outer casings together. When the section had been built up and evacuated, it was put into a special furnace and mounted on a horizontal rotatable shaft and turned, originally by hand, during the heating process to even the fuzing of the foil. This method produced some 10% successful joints; and, by centrifuging at speed during the process, this figure was raised to 60%. 85% successes were hoped for.

44. Each section was pressure-tested to 50 atmospheres after brazing, then machined to finished dimensions, aligned and drilled where necessary.

Assembly of Combustion Chamber

45. Various jigs were devised in order to align the sections during assembly. These were:-

		OKB.	ZAVOD
(a)	1 cast iron cone-location base of venturi	1	1
(b)	1 inlet pipe location jig (Einlanfstutzen)	1	2
(c)	1 thrust frame lugs location jig.	0	2
(d)	6 jigs for combustion head assembly	1 set	
	2 jigs for combustion head hydraulic test	about 8 sets	
(e)	Jigs for hydraulic testing of combustion chamber	1	1

46. The method of joining section to section is shown in Fig. 19. The copper inner casing is flanged outwards at each end. After aligning one section with the next the exposed edges of these flanges are welded together as indicated. [redacted] introduced a special welding electrode having a 1.2% silver content and a potassium 50X1-HUM salt envelope.

47. The next process involves the welding of a flanged machined ring to each of the adjacent steel outer casings in such a way that they form a face-to-face joint. 50X1-HUM The rings are presumably made in sections to facilitate assembly and are machined by drilling to provide passage-ways for the coolant water. The sketch prepared [redacted] (also Fig. 19) suggests that the rings also form a location for the welded flanges of the inner casing. At first sight this appears a somewhat unnecessary refinement which adds greatly to the amount of machining required since a plain machined channel could otherwise have formed the coolant passage-ways. A locating rib on one ring engages in a mating recess in the other and assembly is completed by bolting the rings together at their outer ends.

48. The weaknesses of the system, believed not to be finalised, are apparent. Extremely accurate fixing jigs must be employed if a tight joint is to be achieved and gaps between the rings obviated. The rings joining each section will of necessity have to conform with the contour of the combustion chamber at each joint and will therefore all be different. Tolerances on the combustion chamber dimensions will have to conform to very close limits to facilitate design of the rings and their assembly jigs. The joints so formed do not appear to act as expansion joints, and deformation with heat and pressure seems probable.

On the other hand, there is no real obstacle to having a simple expansion joint between the two outer casing plates as was common practice in the A-4/25 ton unit.

49. The heat transfer characteristics of the assembly were assessed by a laboratory outside KHIMKI and proved satisfactory.

Turbine Assembly and Test Equipment

50. [redacted] the turbine blades were not produced in either the 50X1-HUM OKB or the ZAVOD. [redacted] the rotors came as rough castings and had to be machined and the blades inserted.

51. The turbine was designed to develop 7500 hp. but those tested failed at 80% of this figure. It was a development of the A-4 turbine ([redacted] this was the first design of this type [redacted] attempted). [redacted] the 50X1-HUM OKB should be asked to undertake this work.

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52. A turbine test stand for the 100-ton motor was contemplated in 1950. GLUSHKO ordered drawings for the apparatus, which was intended for research into blade and nozzle design, to be made by a technical High School in MOSCOW which worked with the MOSCOW Academy. The test stand was made at KHIMKI and delivered to the High School in May, 1950. (Fig. 20 shows general layout and dimensions).

53. [redacted] the apparatus contained built-in moveable segments into 50X1-HUM which the turbine blades are fitted. Nozzles are built in and tested at different pressures and speeds. The stand was intended to withstand pressures up to 40 atmospheres and was made in two parts.

It was known as the BTU (V.T.E.) (sic) in the OKB.

Pumps

54. One of the outstanding problems in design of the 100-ton project seems to have been the provision of suitable pumps, and this may well prove a limiting factor in ultimate developments.

55. The contemplated design makes provision for pumping water and hydrogen peroxide in addition to fuel and oxidant.

HISTORY AND FORECAST OF DEVELOPMENT PROGRESS

56. A number of prototype combustion chambers of 8 and 12 tons' thrust were produced and tested prior to September, 1950.

57. By September, 1950, all jigs and tools required for the manufacture of the unit were held in the OKB. Certain parts were ready. [redacted] 50X1-HUM

[redacted] 50X1-HUM

58. Five 100-ton thrust frames had been built by September 1950, (Fig. 21).

59. [redacted] summarised progress thus:- 50X1-HUM

1950 - First mock-up of full scale unit seen by him.

1951 - Zavod jigs ready and first motor from Zavod should be ready for test at the end of 1951.

1953 - Series production could begin by about January, 1953 (surmise only).

[redacted] estimated 1,500 man-hours for combustion chamber and ancillary equipment production plus 800 man-hours for valves, i.e., 2,300 man-hours in all based on production rate of 1,000 units/month. 50X1-HUM

60. [redacted] GLUSHKO was to be awarded a Stalin Prize in the event of the motor functioning properly. 50X1-HUM

NUMBERING AND MARKING

Drawing Numbers

61. For the OKB - 100 - 00.00 for 25-ton motor
101 - 00.00 " 35- " "
120 - 00.00 " 100- " "
experimental motor.

For the ZAVOD 100 - 00.00 for 25 ton motor
101 - 00.00 " 35 " "

A broad secret stamp was on each drawing.

Engine Markings

62. The above markings were also stamped upon the side of one of the supporting lugs of the combustion chambers.

63. When engines had been returned for modification or repair a small printed Russian letter was added as a suffix, e.g., 25 a. [redacted] one engine which had been returned for modification was marked No. 25-9. 50X1-HUM

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Component Markings

64. These were as follows:-

Engine - Project - Series of three figures - Series of three figures,

e.g. 100 123 123

where the first series of three figures represented the component and where the second series of three figures represented the component part.

This followed German practice.

65. No factory marks were used [redacted]

CORRESPONDENCE

66. All correspondence was dealt with by the Soviets. [redacted] headed sheets as here illustrated,

OKB	Official Correspondence	456

67. Some letters were received from the LOMONOSOV Institute, MOSCOW. They were headed as follows:-

LOMONOSOV Institute

Your Ref:
Subject.

Moscow.
Date.

These were signed by four different people, two of whom had German Jewish names.

[redacted]

COURSES

Advanced Course

70. This course in advanced rocketry covering all aspects was started in 1949 (mid) for a minimum period of 2 years. It took place on Tuesday or Wednesday every week at the LOMONOSOV Institute in MOSCOW. It was available to senior members of the staff, and a doctor's degree in rocketry was attainable.

GLUSHKO was both leader of the course and also a lecturer. Other members were:-

(1) First deputy (a Pole)

(2) LIST

(3) WITTKA

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(4) IVANOV (LIST's designer)

(5) H_2 O_2 Pump Designer, name not remembered

(6) ARTAMANOV

(7) Another

(8) KURILOV from Factory No. 88

All the above had Dipl. Ing. or physics degree except ARTAMANOV.

ARTAMANOV finished the course abruptly after one year, having been failed.

[redacted] 50X1-HUM

Courses at OKB

[redacted] 50X1-HUM

Regular Lecturers

The Russian designer gave lectures on structural details and a technician gave talks on production details twice per week to all the OKB staff. No examination was entailed.

Special Lecture

GLUSHKO, in July 1947, gave one lecture to 60 members of the staff during which the 100-ton project was introduced. Germans were asked how to tackle the development. One Russian said that it could not possibly be brought to fruition within five years.

Movement of Personnel

(a) [redacted] some 20 Russian technicians [redacted] had been at THURINGEN. 15 of these had left [redacted] of whom some [redacted] went to Factory No. 88. 50X1-HUM

Two or three came back to OKB, assembly shop for two months and departed again in early 1950. When they were back they were very flush with money. [redacted] they had been in a remote part of the country, as it is standard practice under such circumstances to pay additional allowances, which are paid to the worker and not to his family. 50X1-HUM

(b) [redacted] GLUSHKO and some technicians had previously worked at KAZAN, where GLUSHKO was concerned with assisted take-off units. 50X1-HUM

The following detail was described [redacted] as "Men from KAZAN":- 50X1-HUM

Arrested by Soviets before 1941.

(1) GLUSHKO - Chief Designer
(2) SEWICK - 1st Deputy
(3) WITTKA - 2nd Deputy
(4) LIST - Department Chief in Designing Office
(5) Prof. GAB RIELOV - Group Leader in Designing Office
(6) ATAMANOV - Manager
(7) CHUSHENKO - Foreman for Work preparation
(8) MUSHENKO - Foreman of Mechanical Workshop
(9) AGAFONOV - Foreman for Pumps in Design Office
(10) - Foreman for Hydrogen Peroxide Dept. in Design Office.

Further, about 3 Masters (presumably master craftsmen)
5 Technologists
and about 20 Specialist Workmen.

GLUSHKO

71. Previously associated with ATO units in KAZAN, appears to be a leading personality on the combustion side. Has written a book on physics and gave lectures at the LOMONOSOV Institute, MOSCOW. He was given preferential treatment and sent away to recuperate when ill.

GABRIEL, Professor

72. Worked as LIST's Deputy. In 1949 got drunk and made disparaging remarks about the regime. Returned to 456 after 6 months in the mines. 50X1-HUM

ZASSANOV, b. 1910

73. Engineer [redacted] Training had consisted of 4 years mechanic. He had done a mechanic's apprenticeship and technical school.

ZAKHAROV- Foreman

74. One of three attached to OKB. on a course. Remained at OKB.

75. In 1948, when the Germans changed jobs some clever young Russians came in from the high school [redacted] 50X1-HUM

AWARDS

76. During the period late 1949 - early 1950 the leading personality in rocket research was awarded a first class STALIN prize. Another leading Russian engaged in rocket research obtained a lesser prize.

GLUSHKO had been promised a STALIN prize when the 100-ton thrust motor was capable of operation. 50X1-HUM

[redacted] impression that personnel connected with guided missiles had received a higher proportion of merit awards than he would have expected, possibly indicating high priority for guided missiles.

THE V-1.

77. [redacted] In 1946, large numbers of V-1 parts brought from Germany were being assembled by a section of the Soviet staff. 50X1-HUM [redacted] the air bottles and the engines were manufactured in Factory 456 [redacted] 50X1-HUM

78. [redacted] 40 German V-1s and 20 Soviet V-1s were manufactured before mid-1949, when production ceased. In addition, 100 air bottles and power units were made. This production was of the standard German designed V-1. [redacted] 50X1-HUM

SCIENTIFIC ORDER OF BATTLE - PERSONALITIES

ZAVOD 456

GLUSHKO

1. Chief Designer, also leader of the advanced course in rocketry held at the LOMONOSOV Institute in MOSCOW. Gave lecture to 60 members of the staff, during which the 100-ton rocket project was introduced. He has written a book on physics, and is believed to have been promised a STALIN prize if the 100-ton project proved successful. Formerly associated with R.A.T.O. at KAZAN, and prior to 1941 was arrested by the Soviets.

SEWICK

2. First Deputy to GLUSHKO, formerly of KAZAN and prior to 1941 arrested.

WITTKA

3. Second Deputy, formerly of KAZAN and prior to 1941 arrested.

LIST

4. Department chief in design office, formerly of KAZAN, and prior to 1941 arrested. Member of the advanced course.

Prof. GABRIELOV

5. Group leader in design office, also LIST's deputy. In 1949 while drunk made disparaging remarks about the regime. Returned to ZAVOD 456 after six months in the mines.

ARTAMANOV

6. Manager of factory. Member of the advanced course but was failed after one year.

IVANOV

7. LIST's designer, also member of the advanced course.

ZASSANOV - b. 1910.

50X1-HUM

8. Production engineer in charge of O.K.B. production [redacted] Training had consisted of mechanic's apprenticeship and Technical school for a total period of four years.

KURILOV

9. Although described as coming from Factory 88, he was also a member of the advanced course.

10. The above personalities with the exception of ARTAMANOV have either the Dipl. Ing. or a physics degree.

ZAKHAROV

11. One of the three foreman attached to O.K.B. for a course. After the course he remained at O.K.B. [redacted] 50X1-HUM

WEBER

12. In 1948, when the Germans changed jobs some clever young Russians came in from high school. [redacted]

CHUSHENKO

13. The foreman for work preparation.

MUSHENKO

14. The foreman of the mechanical workshop.

AGAFONOV

15. The foreman in charge of pump work. Designated as being in the design office.

16. In addition to the above, another foreman was in charge of the Hydrogen Peroxide department who is also designated as being in the design office.

17. The following numbers and grades of personnel were also given:-

approximately 3 mastercraftsmen
5 technologists
20 specialist workmen

LIST OF MACHINE TOOLS, OKB Workshop

1 - Lathe, 3 meters long, 250 mm. capacity

1 - Mechanical stamping press

1 - Hand

2 - Radial drills

2 - Folding presses

3 - Flanging machines

3 - Table drills

4 - Spot welding machines

1 - Roll (Seam ?) welder. (Rollenschweiss)

1 - Hydraulic test stand (300 atmospheres) for pipes and tanks

2 - Hydraulic test stand (hand operated) for soldering

1 - Tube roller

1 - Tube bender

1 - New "deep" furnace for 100-ton unit.

1 - Swinging and turning device for combustion chamber, welding machine.

1 - Table shear

1 - Profile cutter

1 - Outside shears

1 - Transformer

2 - Gas welders

4 - Emery wheels

FIGURE 1. - Layout of Factory 456 - OKB and ZAVOD

" 2. - Representation of A-4/35-ton motor

" 3. - Assembly jig and construction of inner casing

" 4. - Welding table

" 5. - Section of combustion chamber - longitudinal stringers

" 6. - Assembly of combustion chamber head

" 7. - Concentricity gauge, combustion chamber assembly

" 8. - Location jigs - alcohol entry ports

" 9. - Location jigs - thrust frame supports

" 10. - Representation of assembly line

" 11. - Air pressure test - combustion chamber

" 12. - Modification to coolant jacket - A-4/35-ton motor

" 13. - Modification to coolant connecting pipes and entry ports

" 14. - Modification to coolant entry ports

" 15. - Steel air storage tank

" 16. - 100-ton thrust unit - general layout of combustion chamber

" 17. - Section through combustion chamber - 100-ton unit

" 18. - Jig "D"

" 19. - Joint between sections of combustion chamber - 100 ton unit

" 20. - Turbine test stand

" 21. - 100-ton thrust frame

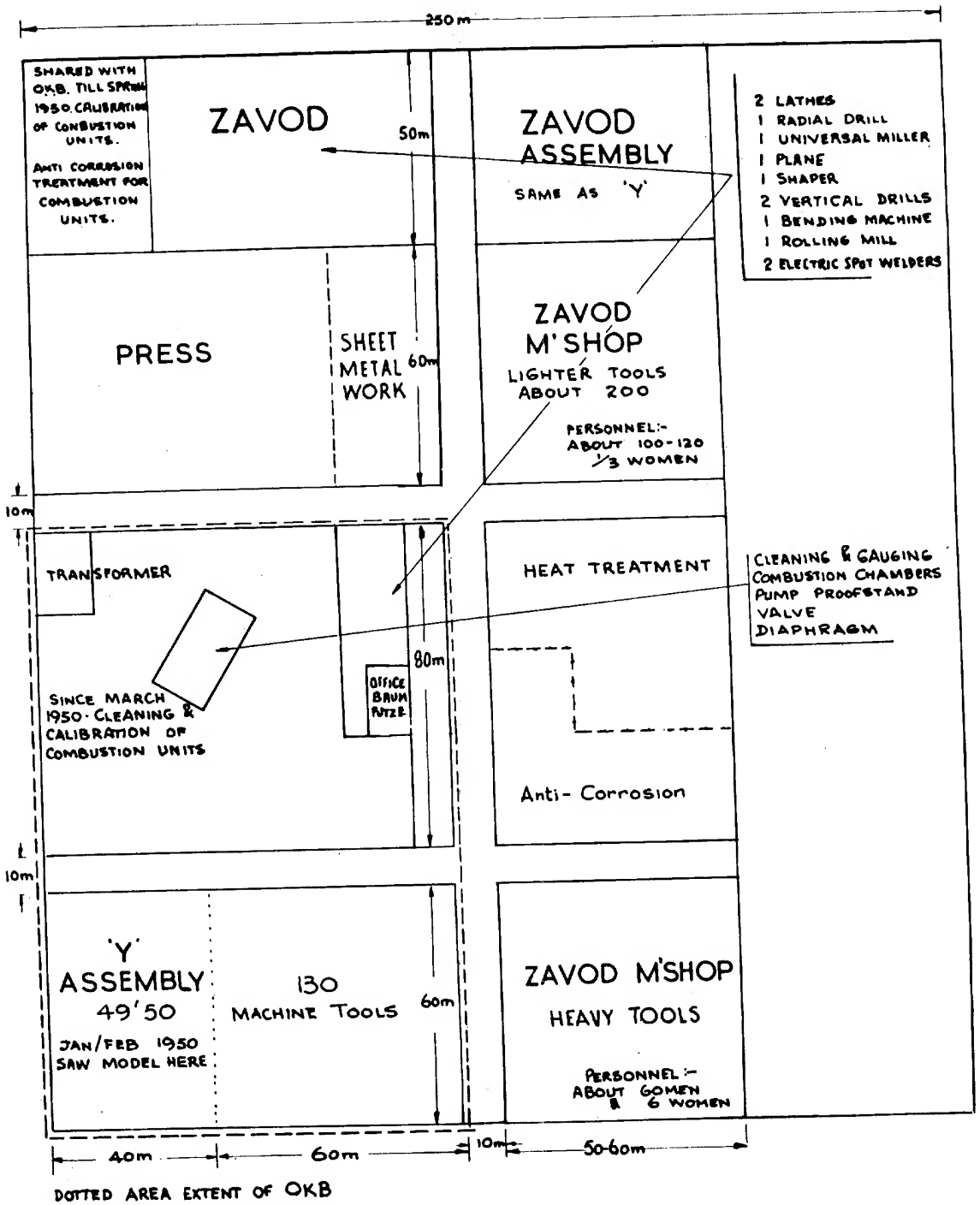
SECRET/CONTROL-U.S.

COPY

CIRCULATE

FIG 1

50X1-HUM



FACTORY 456

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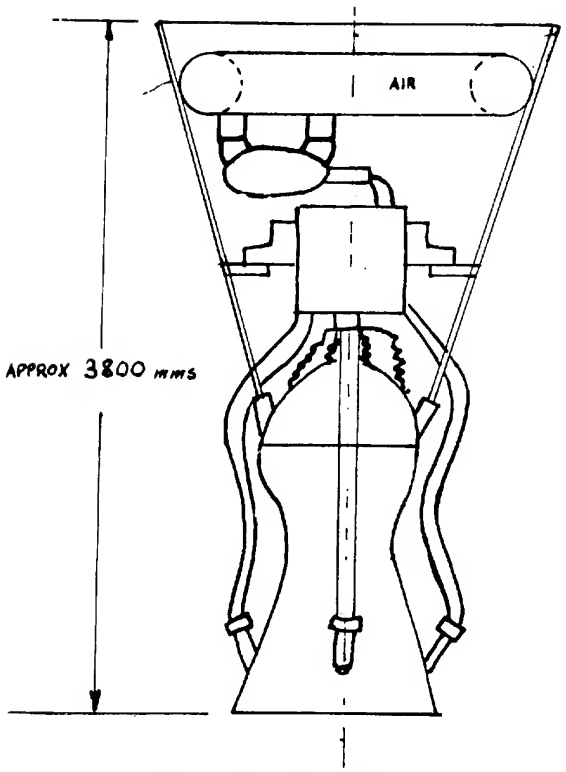
50X1-HUM

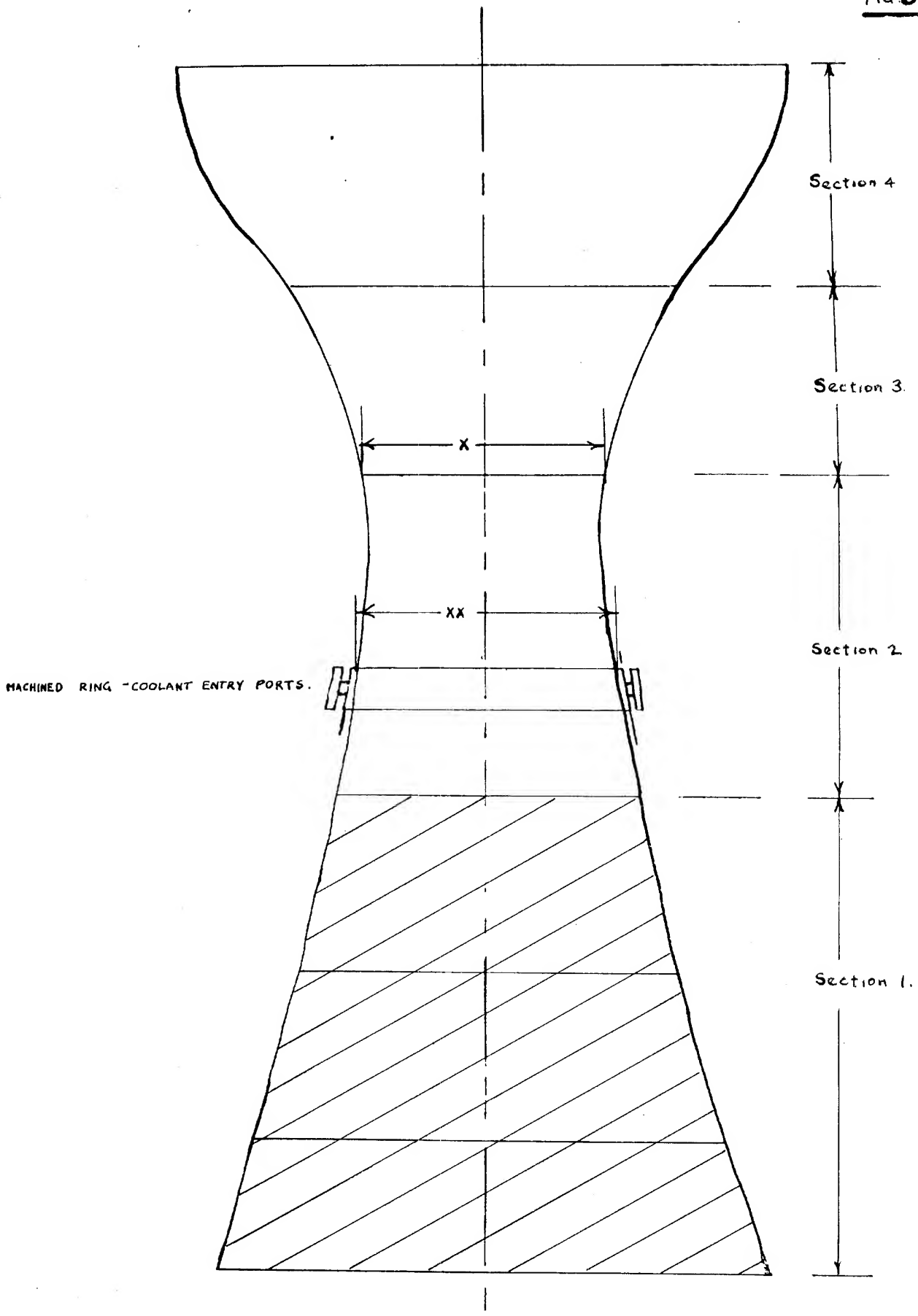
SECRET

FIG. 2.



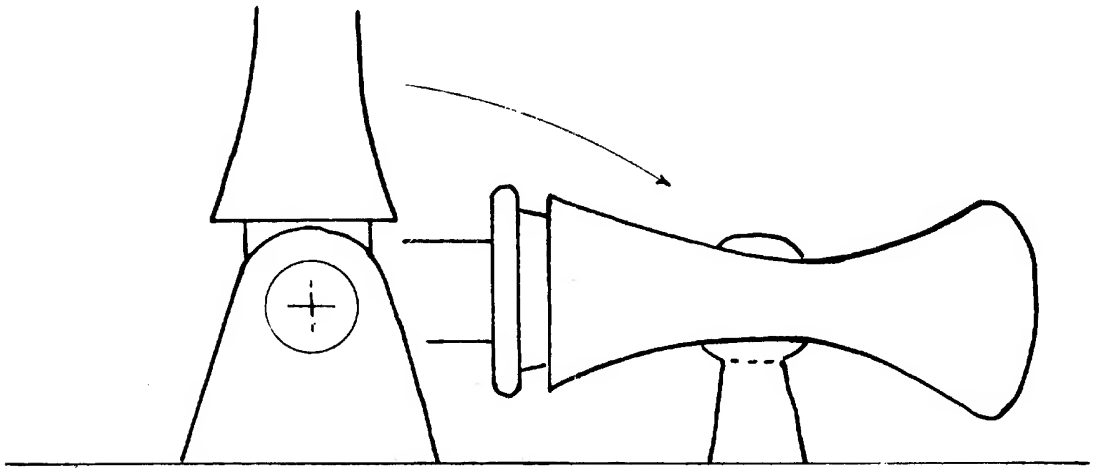
GENERAL LAYOUT - 35 TON THRUST UNIT.

Fig 3.



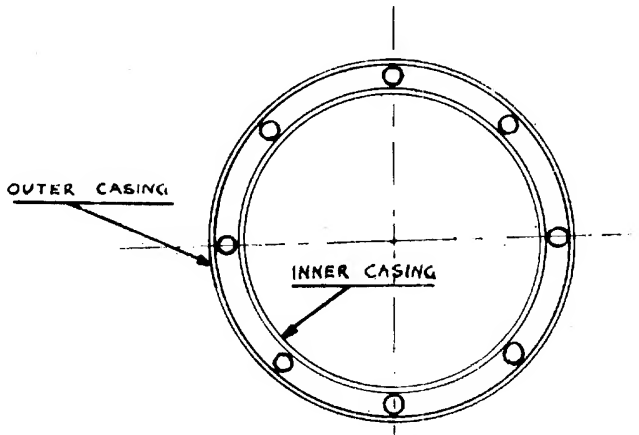
ASSEMBLY JIG (SHADED) AND CONSTRUCTION OF INNER CASING.

T FIG. 4.



WELDING TABLE

FIG. 5.



SECTION THROUGH CHAMBER & LONGITUDINAL STRINGERS

25/35 for throat sections

FIG 6

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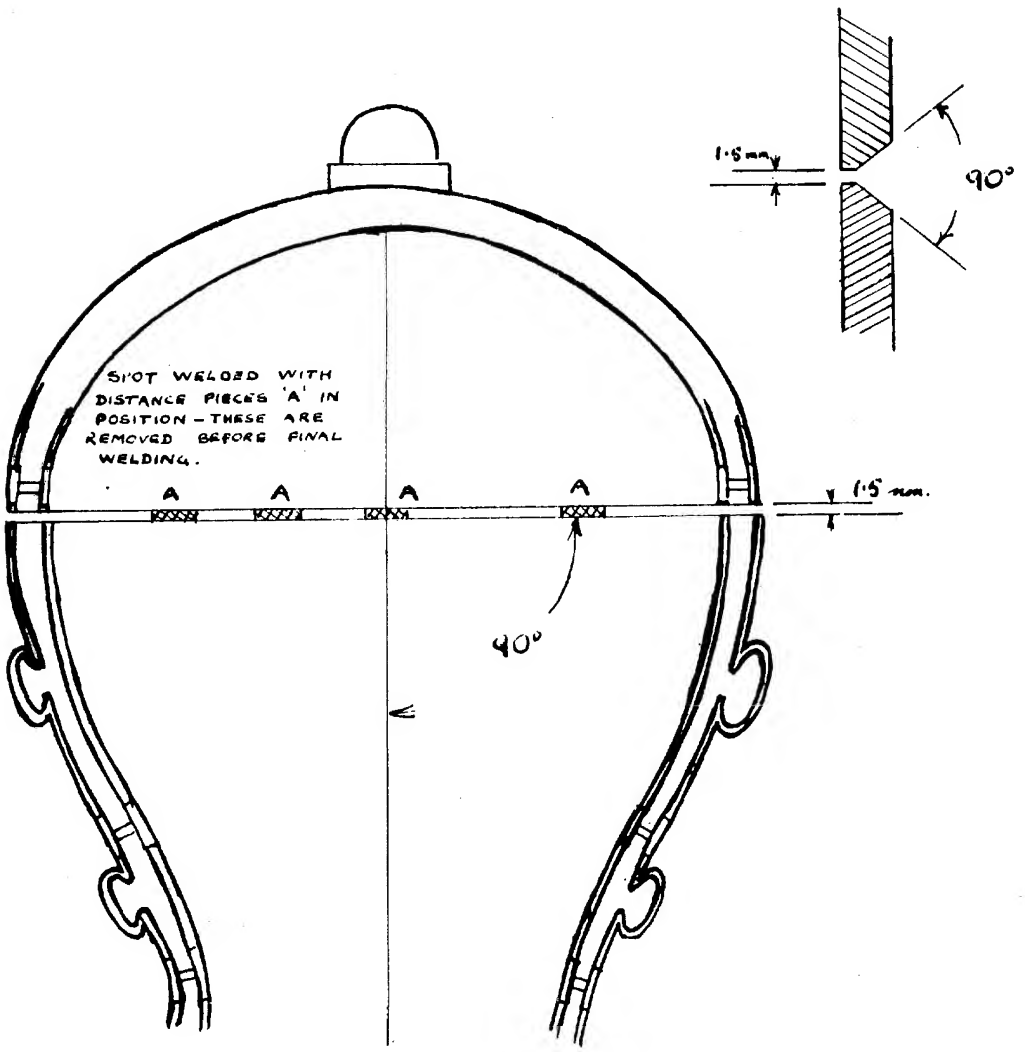
50X1-HUM



ASSEMBLY OF COMBUSTION CHAMBER HEAD.

50X1-HUM

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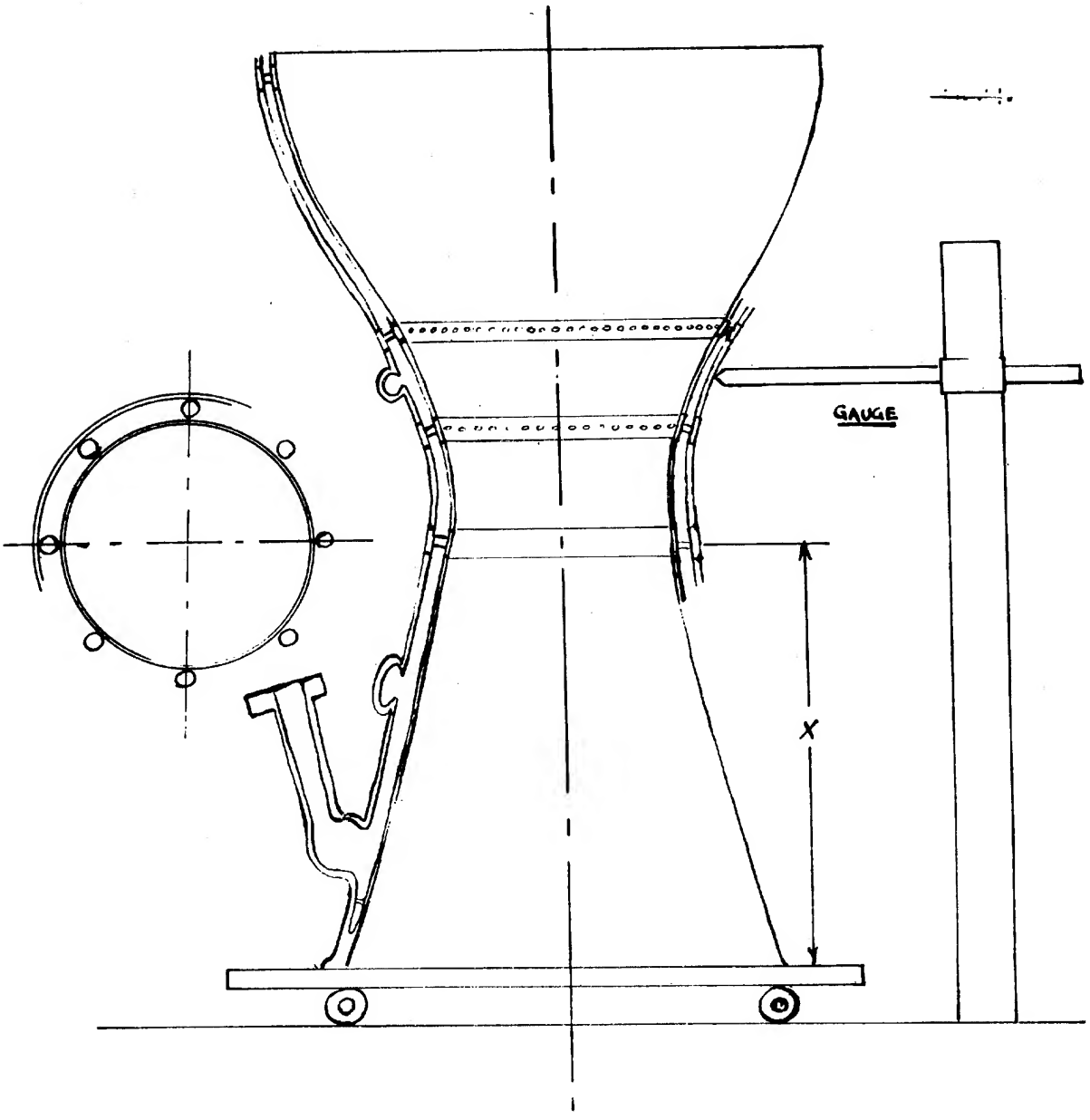
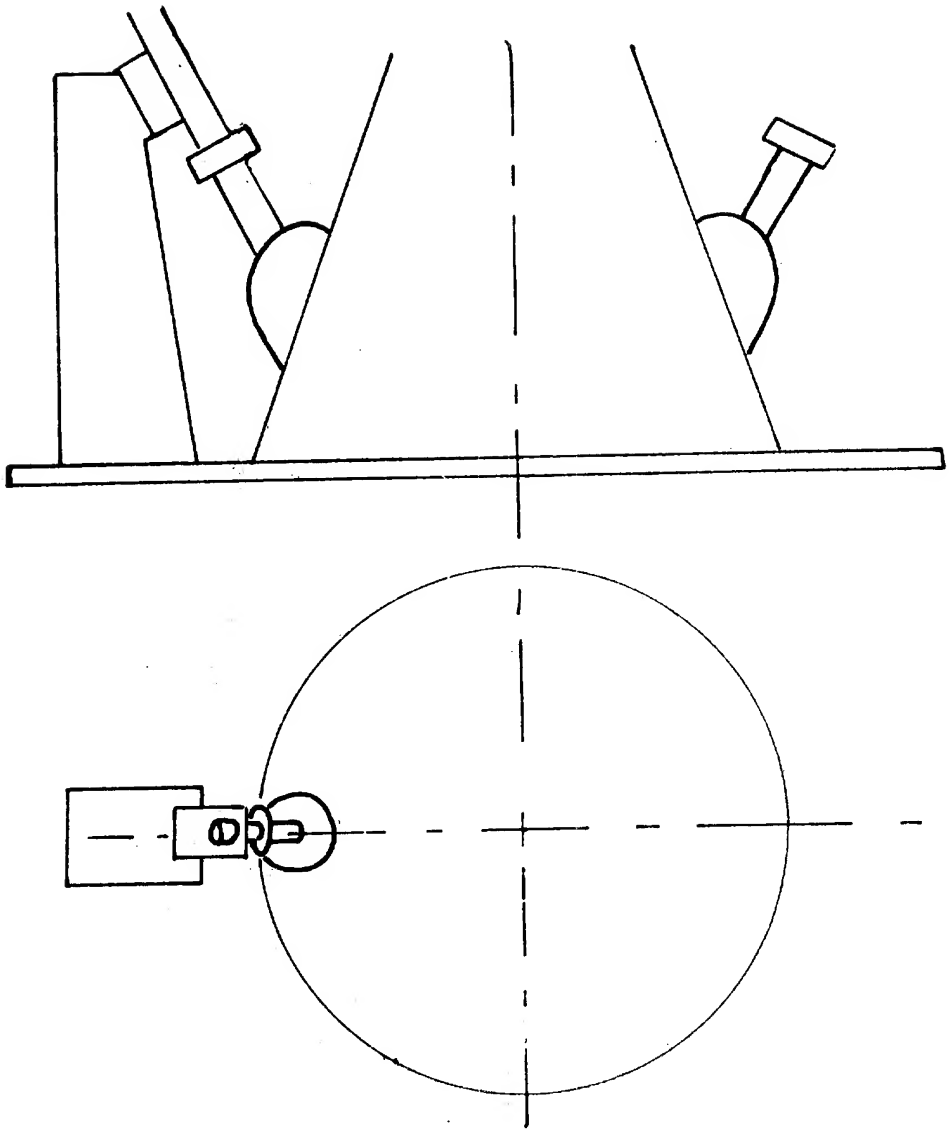
FIG. 7.



CONCENTRICITY GAUGE - COMBUSTION CHAMBER ASSEMBLY.

50X1-HUM



LOCATION JIG - ALCOHOL ENTRY PORTS.

50X1-HUM

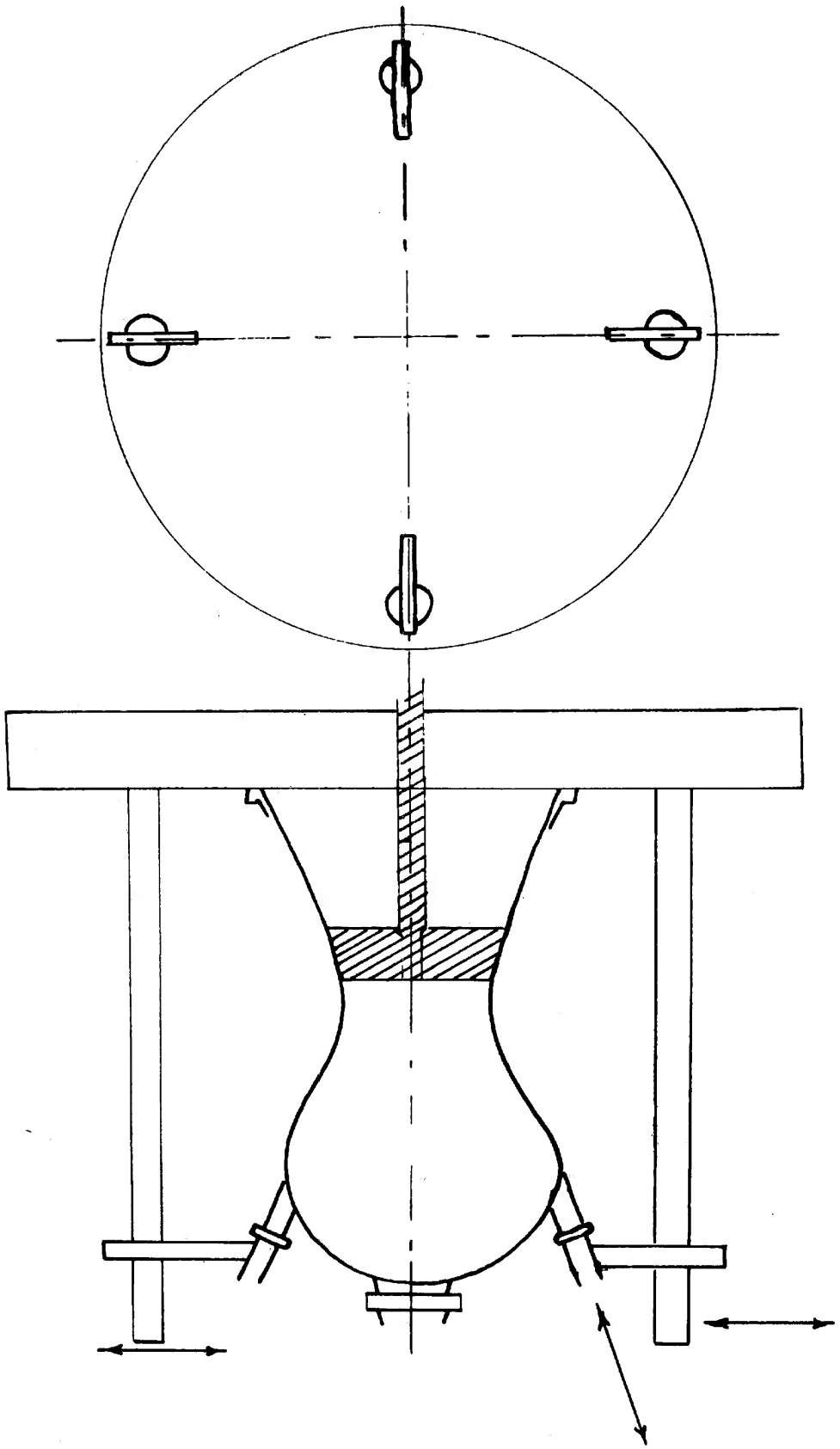
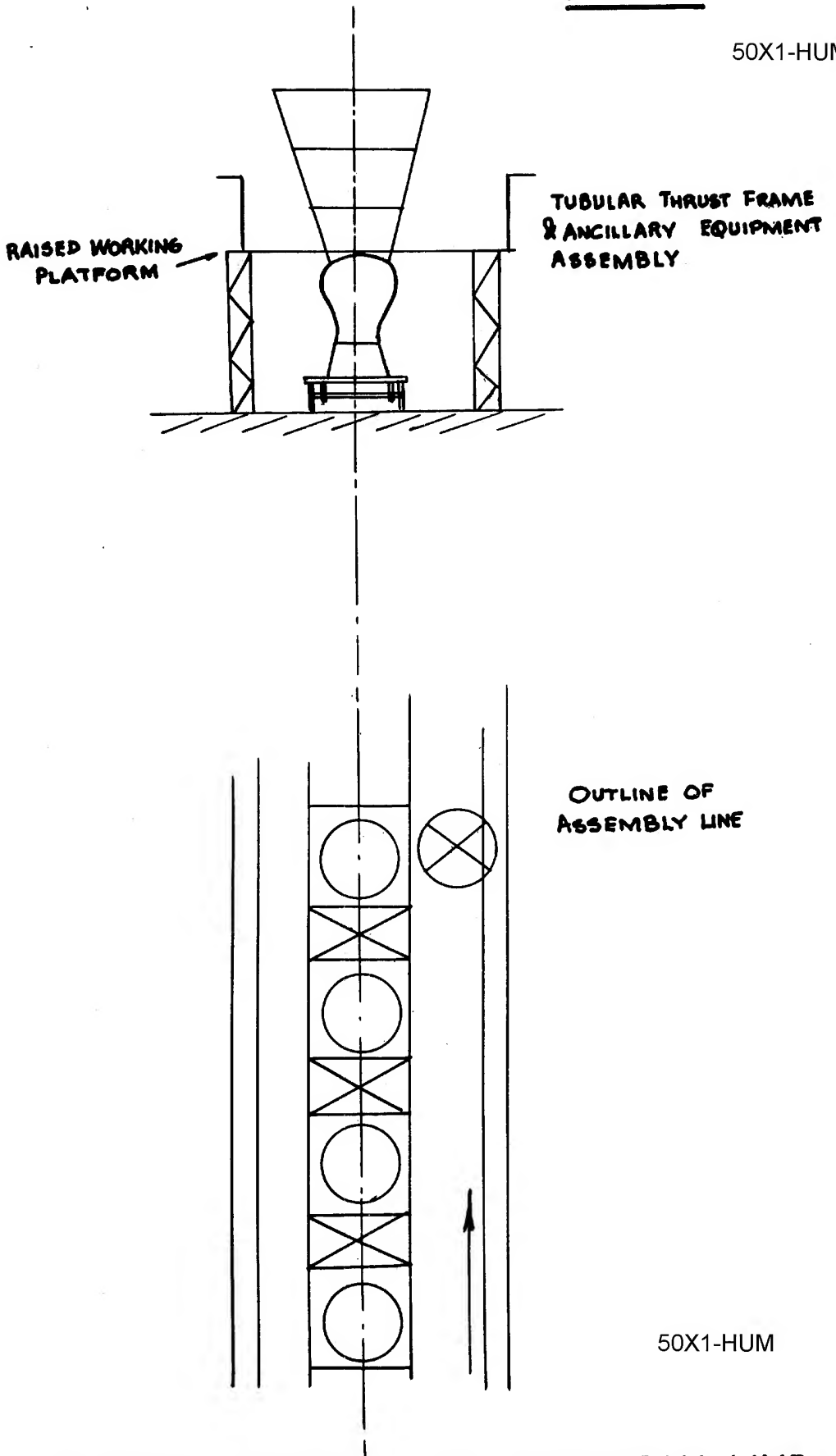


FIG. 10

50X1-HUM



50X1-HUM

REPRESENTATION OF ASSEMBLY LINE

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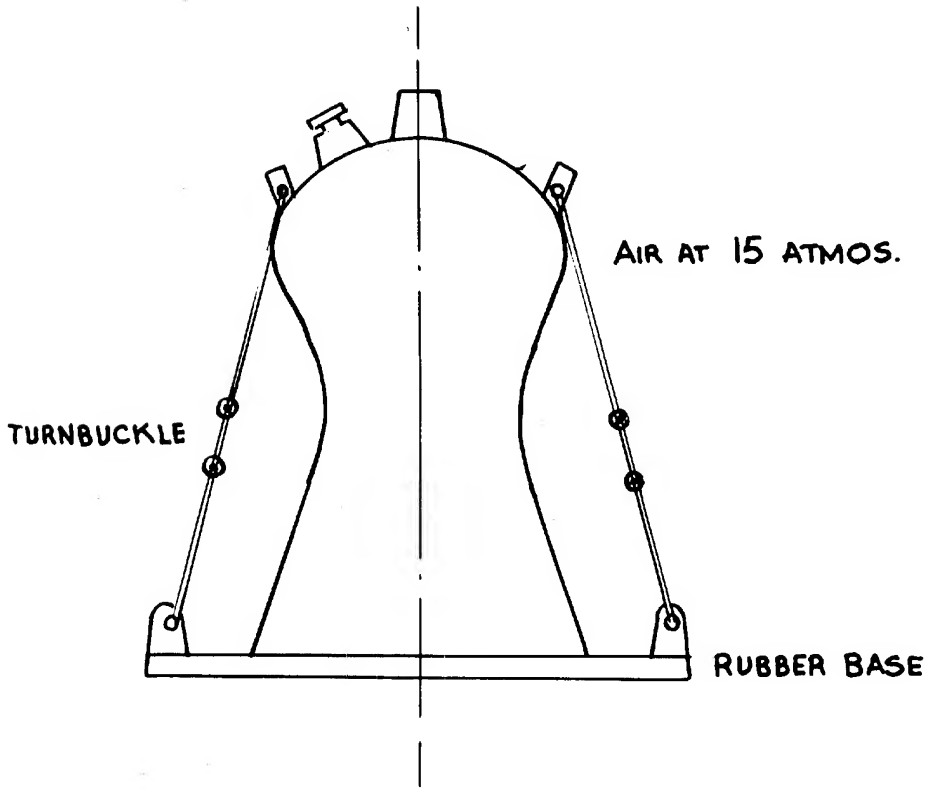
50X1-HUM

FIG. 11



PRESSURE LEAKAGE
TEST JIG FOR PIPE CONNECTIONS

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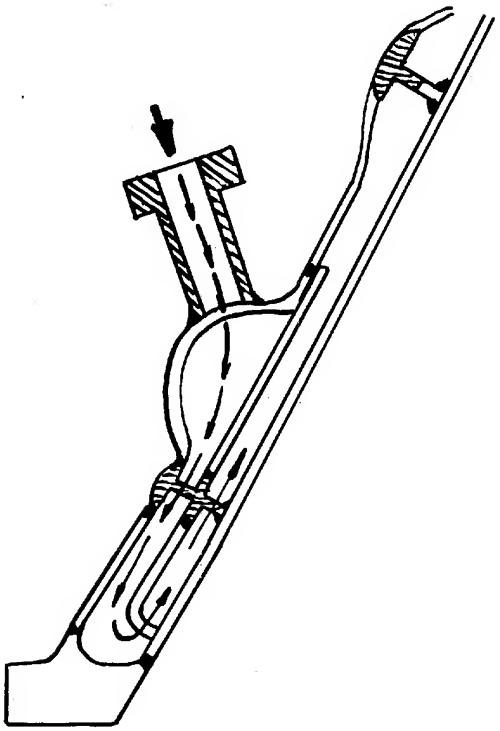
50X1-HUM

FIG. 12



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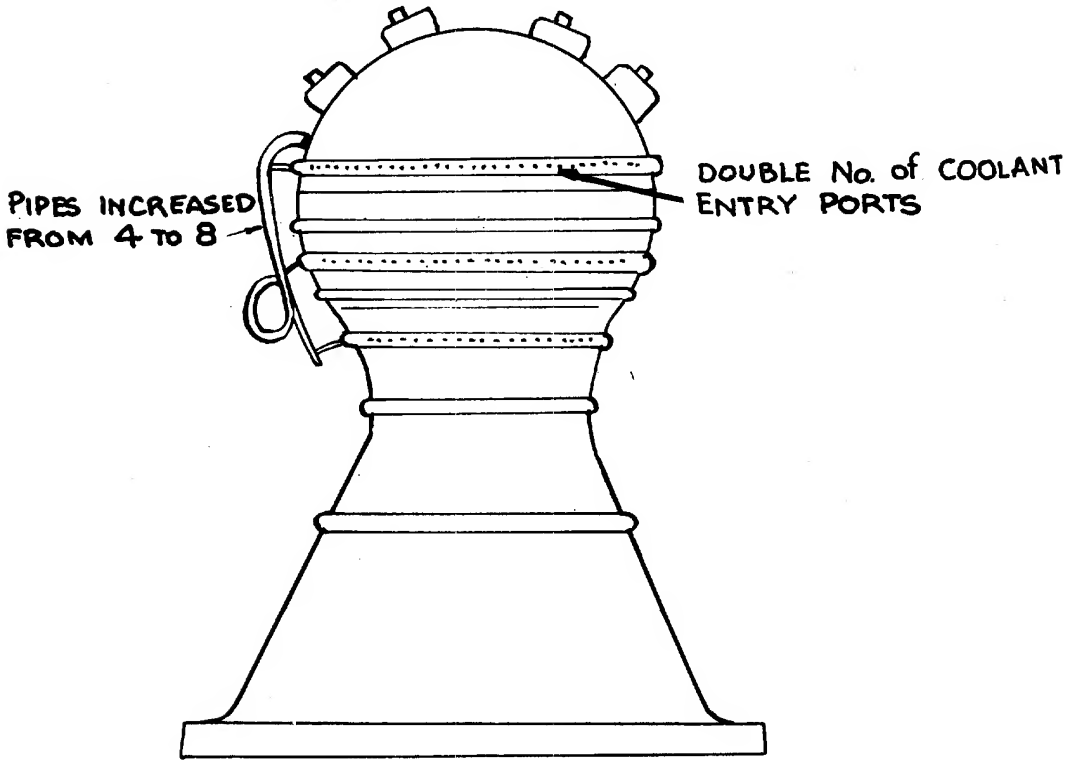
MODS. TO COOLANT JACKET

FIG. 13

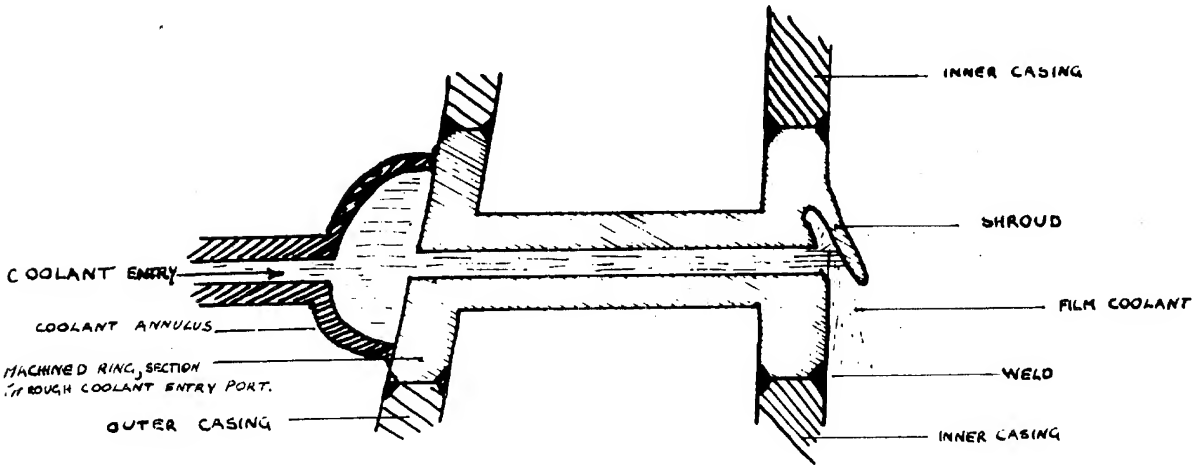


MODS. TO COOLANT CONNECTING PIPES AND ENTRY PORTS.

50X1-HUM

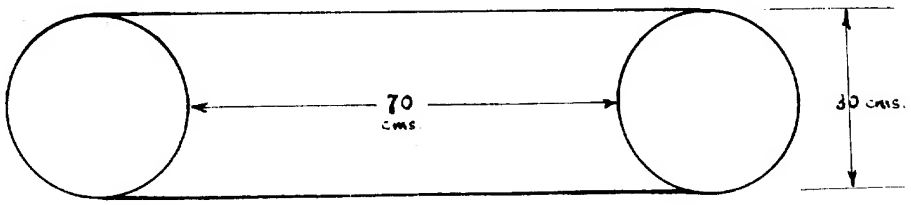
FIG 14.

50X1-HUM



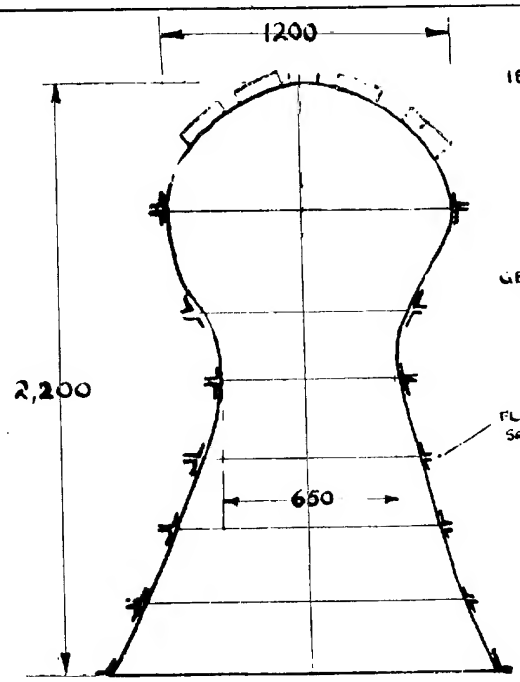
MODIFIED COOLANT ENTRY PORT WITH SHROUD TO DEFLECT COOLANT ALONG CHAMBER WALL.

FIG. 15



STEEL AIR STORAGE TANK

FIG. 16.



18 HEAD ELEMENTS

100 TON THRUST UNIT

GENERAL LAYOUT OF COMBUSTION CHAMBER AND EXTENT OF SEVEN COMPONENT SECTIONS

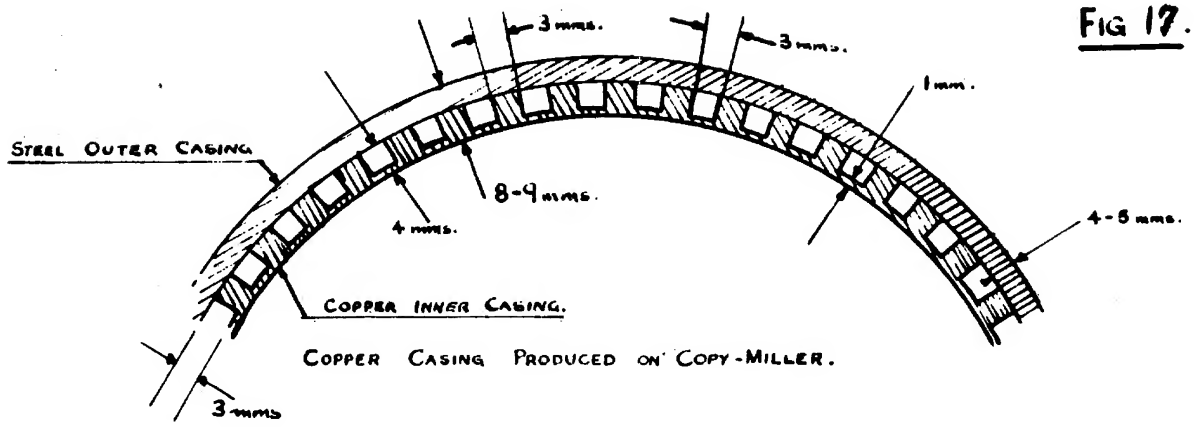
FLANGED ENDS OF SECTION SEE FIG. 18 FOR DETAIL.

ALL DIMENSIONS (mms) APPROXIMATE.

50X1-HUM

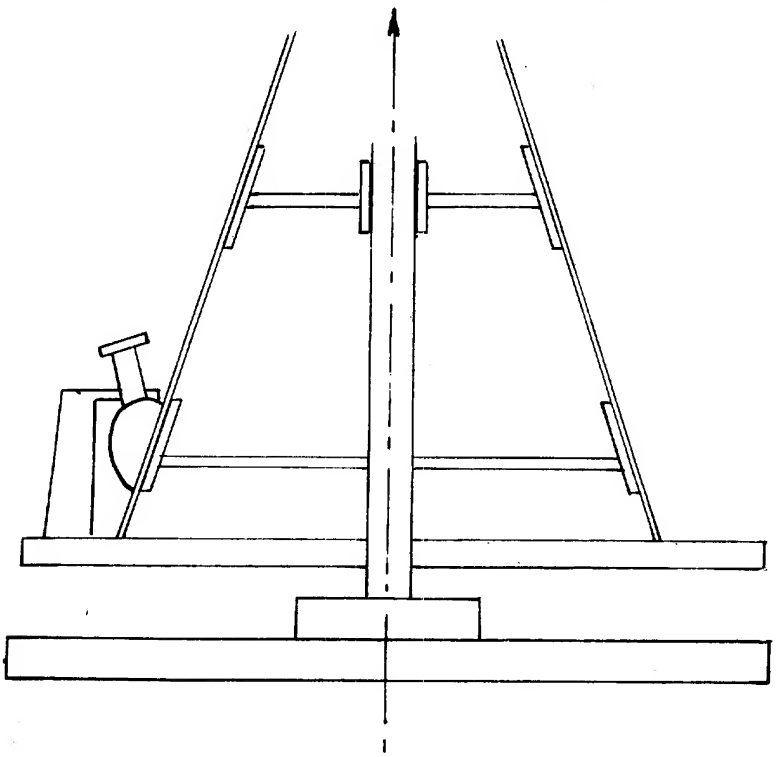
50X1-HUM

FIG 17.



SECTION THROUGH COMBUSTION CHAMBER – 100 TON UNIT.

FIG 18



JIG 'D'

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FIG 19

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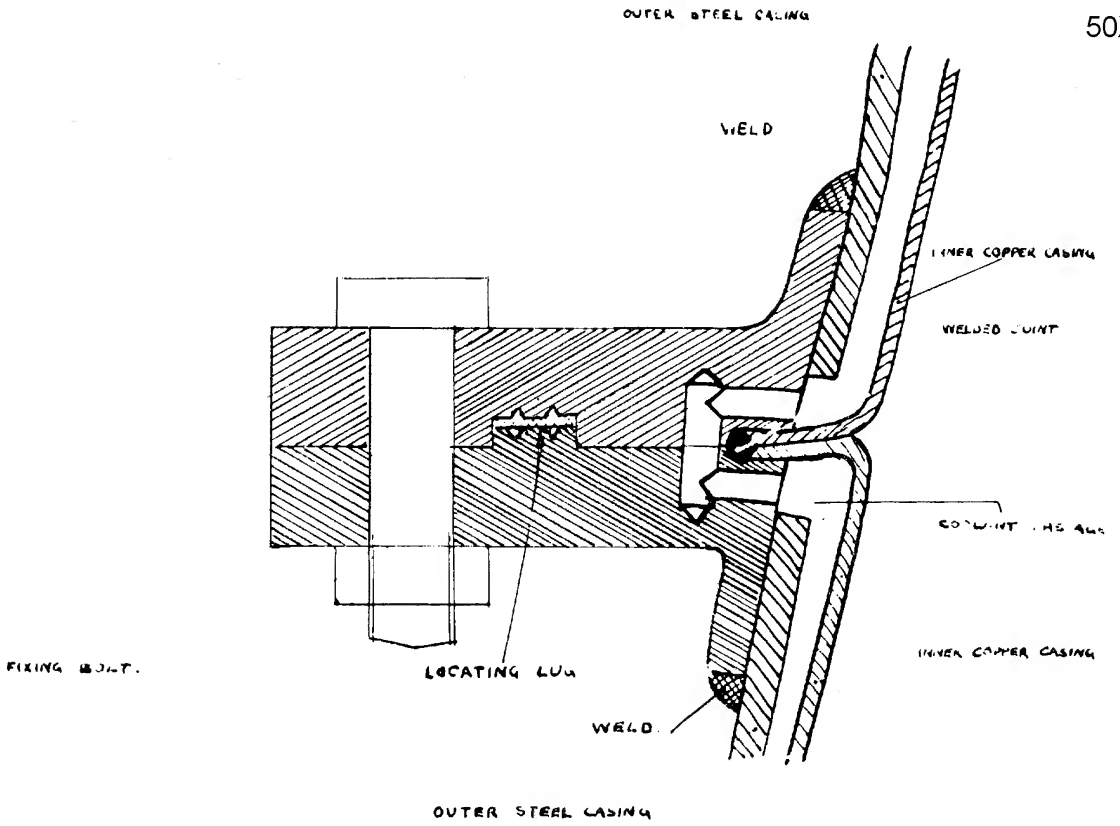
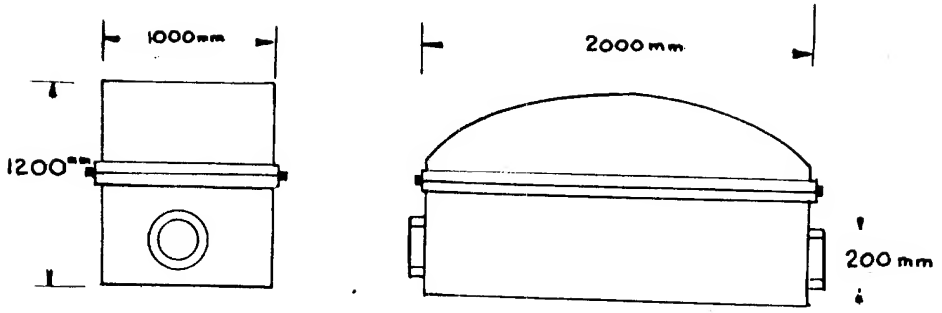


JOINT BETWEEN SECTIONS OF COMBUSTION CHAMBER.

FIG. 20



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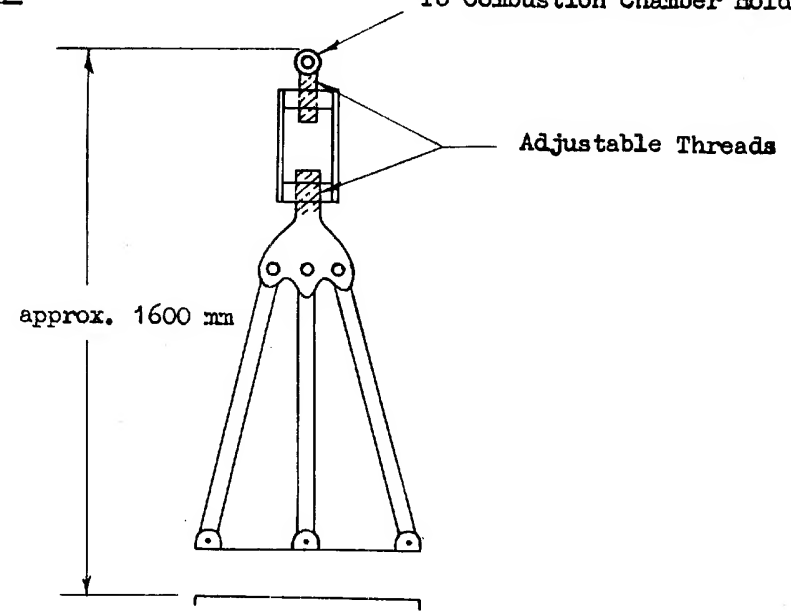
TURBINE TEST STAND

FIG. 21

THRUST BAR ASSEMBLY T



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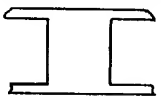
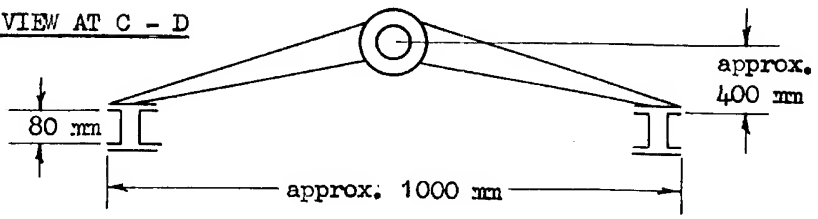
SECTIONAL VIEW AT A - B



VIEW FROM BELOW

MAIN BALANCE ATTACHMENT

SECTIONAL SIDE VIEW AT C - D



100 TON THRUST FRAME

SECRET

50X1-HUM